Gamma Knife Radiosurgery in Cerebral Arteriovenous Malformations

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In order to define the factors of importance for the obliteration of arteriovenous malformations, thus making a prediction of the probability of both obliteration and radiation damage, we reviewed our 1007 AVMs treated with Leksell Gamma Knife. Leksell gamma Knife Radiosurgery was indicated in small and medium sized AVMs in deep brain location or in critical brain regions that cannot be safely surgically resected.

Successful complete obliteration (cure) requires complete disappearance of the pathological shunting of vessels, normalization of the intracranial vasculature, and absence of early draining vein. AVM obliteration is related to the original AVM volume, which in turn influences the dose selected. AVMs obliteration is achieved through proper imaging definition of the nidus, the proper configuration of isodose plan and the optimal radiation dose delivered for the desired effect.

The obliteration rate increased both with increased minimum margin dose average dose and decreased with increased AVM volume. The higher the minimum dose, the higher the chance for total obliteration and was the decisive factor for the treatment result. Peripheral dose between 18 to 25 proved to be sufficient for AVMs obliteration in most cases. Minimum margin dose beyond 25 Gy are unlikely to sub-

stantially improve the AVMs obliteration rate and only increase complication. We had studied the parameters involved and the role of them in the induced radiation damage. Higher integral dose volume was the best determinant for undue radiation effects and we treated to define it quantitatively.

The following figure illustrate the relationship of integral dose / volume with an optimal dose and risk of complications.

Considering IDV inside malformation as a way to measure radiation toxicity and radiation damage probability, our experience indicates that all patients treated with IDV below 155 Gy.cm³ showed no radiation edema during follow-up MRI images. On the other hand patients treated over 200 Gy.cm³ seem to have a high probability of transitory undesired effects, which become severe and symptomatic at 300 Gy.cm³.

The IDV transition range from 155 to 200 Gy.cm³ may be considered as a low-medium complication probability band.

As AVM volume increases prescribed dose has to be reduced in order to keep IDV within safe limits in spite of related reduction in response rate.

In our present practice IDV over 300 Gy.cm³ is always denied and allowed over 200 Gy.cm³ only for special cases of big AVMs outside

eloquent areas with no alternative therapies. For those cases complication probability, its expected level and appearance time can be well predicted for a considerable better handling.

Additional considerations seem to be convenient for big AVMs in children, AVMs in special eloquent locations or AVMs previously treated by endovascular methodologies.

Finally we propose Leksell Gamma Knife radiosurgery as initial management for asymptomatic AVMs, for adult patients with long his-

tory of epilepsy without haemorrhage, and in small to middle sized AVM located in inaccessible areas.

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